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(54) **FUEL CELL**

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(52) **U.S. Cl.**
USPC **429/508**; 429/511

(58) **Field of Classification Search**
USPC 429/507, 508, 511
See application file for complete search history.

(56) **References Cited**

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Primary Examiner — Stephen J. Kalafut

(57) **ABSTRACT**

A fuel cell is disclosed. The fuel cell can include a membrane electrode assembly (MEA), converting a chemical energy to an electrical energy; a first end plate, stacked on one surface of the MEA and formed with a first coupling hole; a second end plate, stacked on the other surface of the MEA; and a protrusion, formed on the second end plate such that the protrusion penetrates the first coupling hole and an end part of the protrusion protrudes a surface of the first end plate, and the end part being transformed such that the end part couples the first end plate and the second end plate. With the present invention, the fuel cell can reduce contact resistance between elements and its overall size and prevent a leak of fuel. In the manufacturing process, the end plates and the MEA can be arranged, improving reproducibility and repetition for mass production.

2 Claims, 3 Drawing Sheets

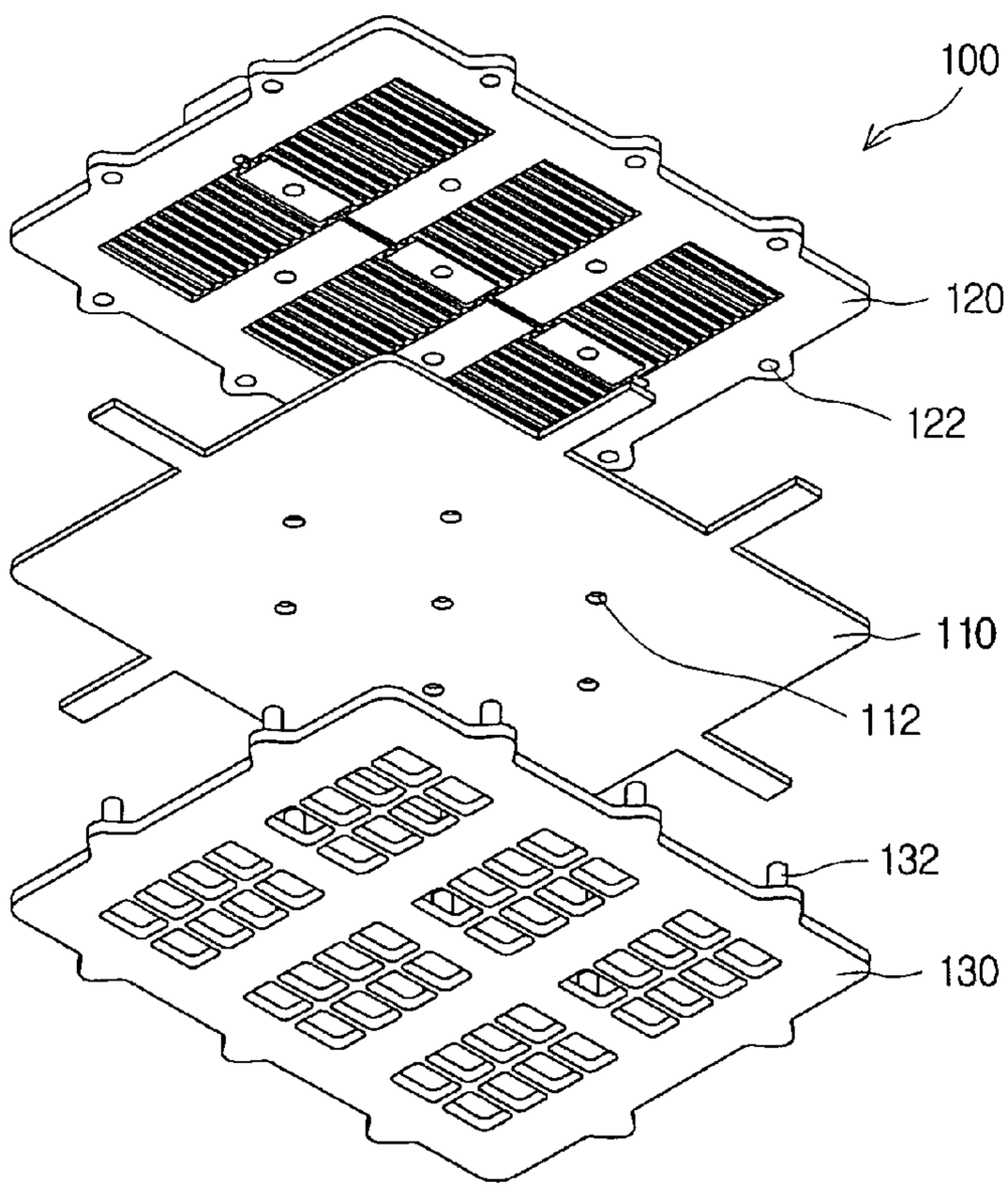


FIG. 1

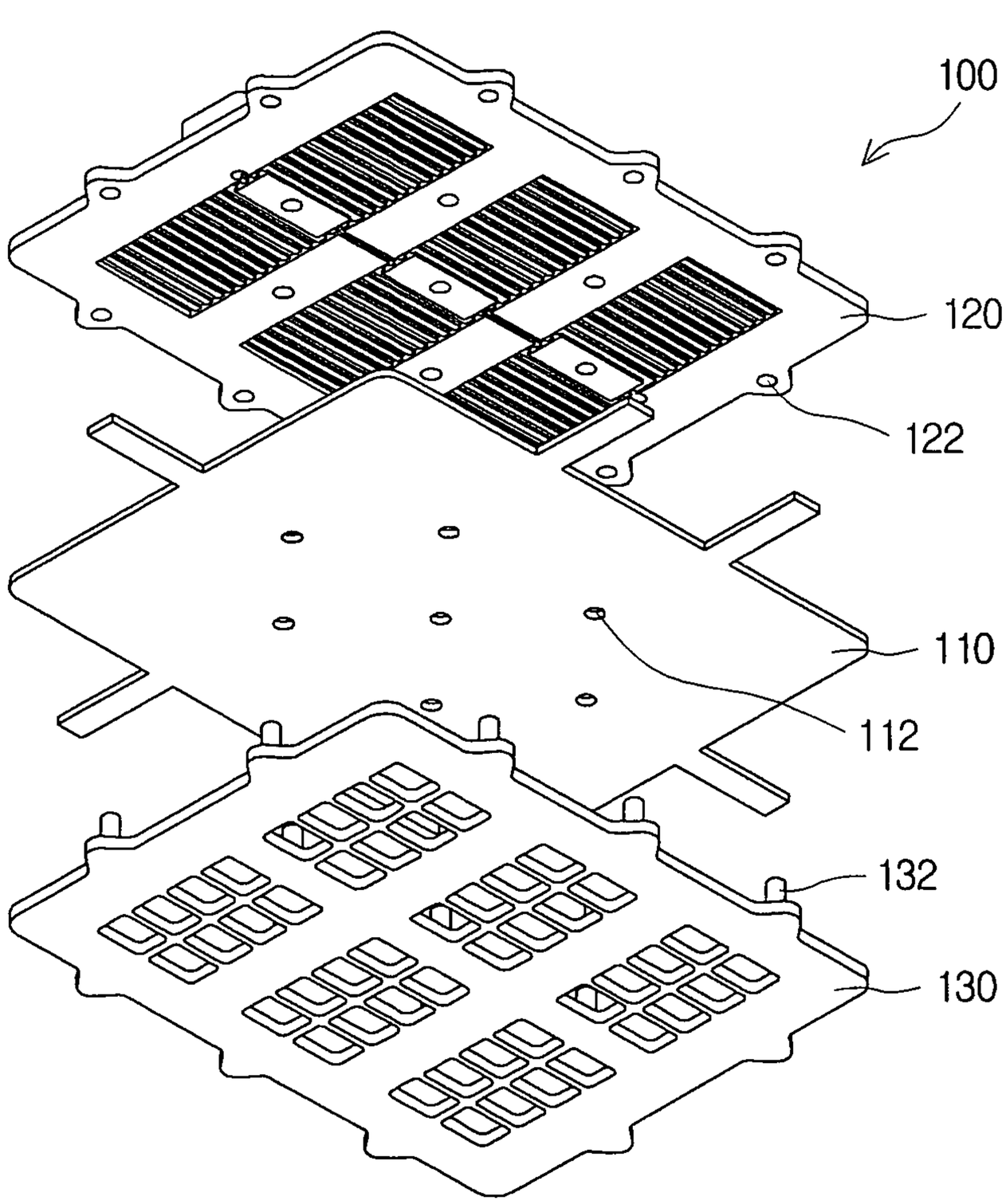


FIG. 2

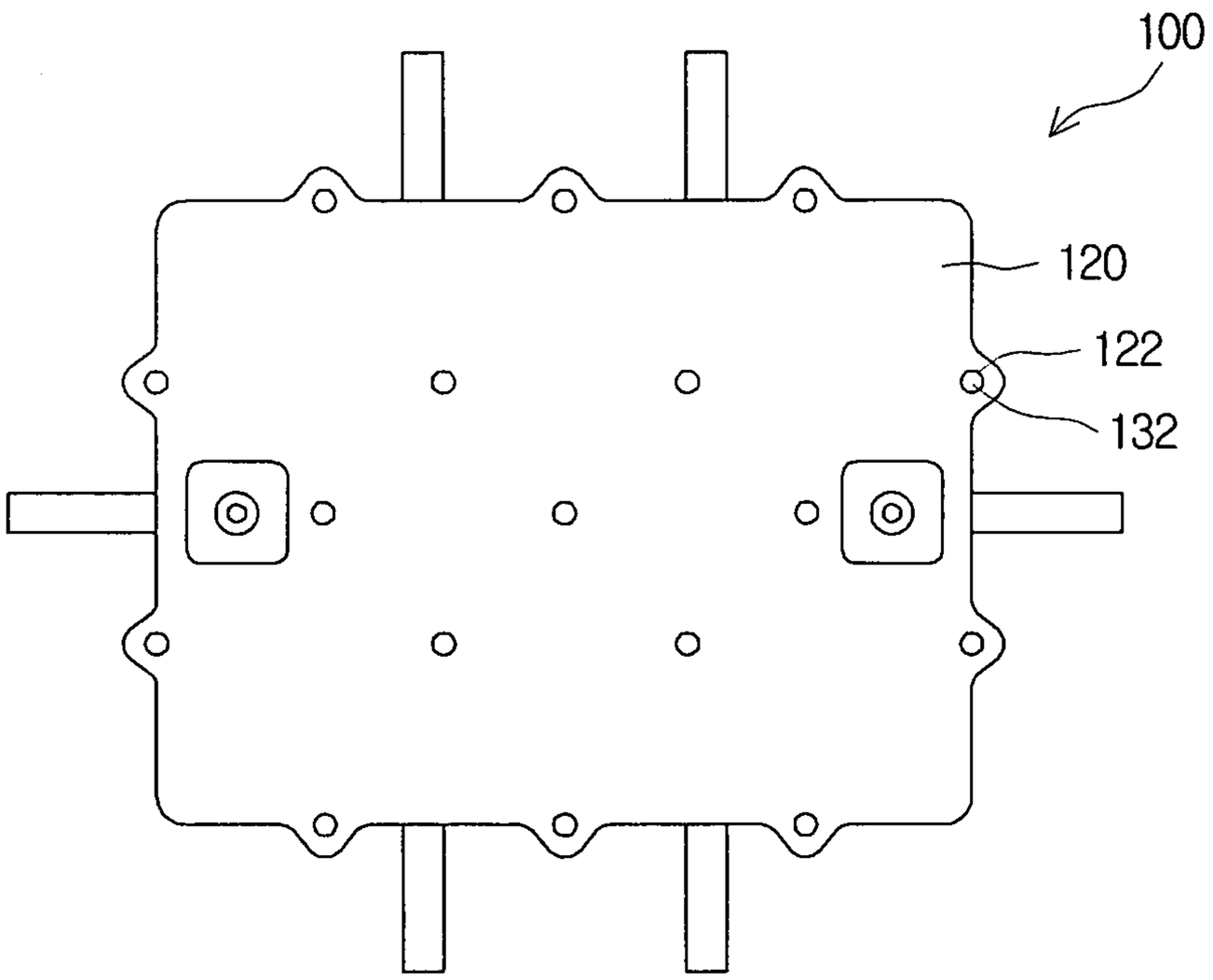
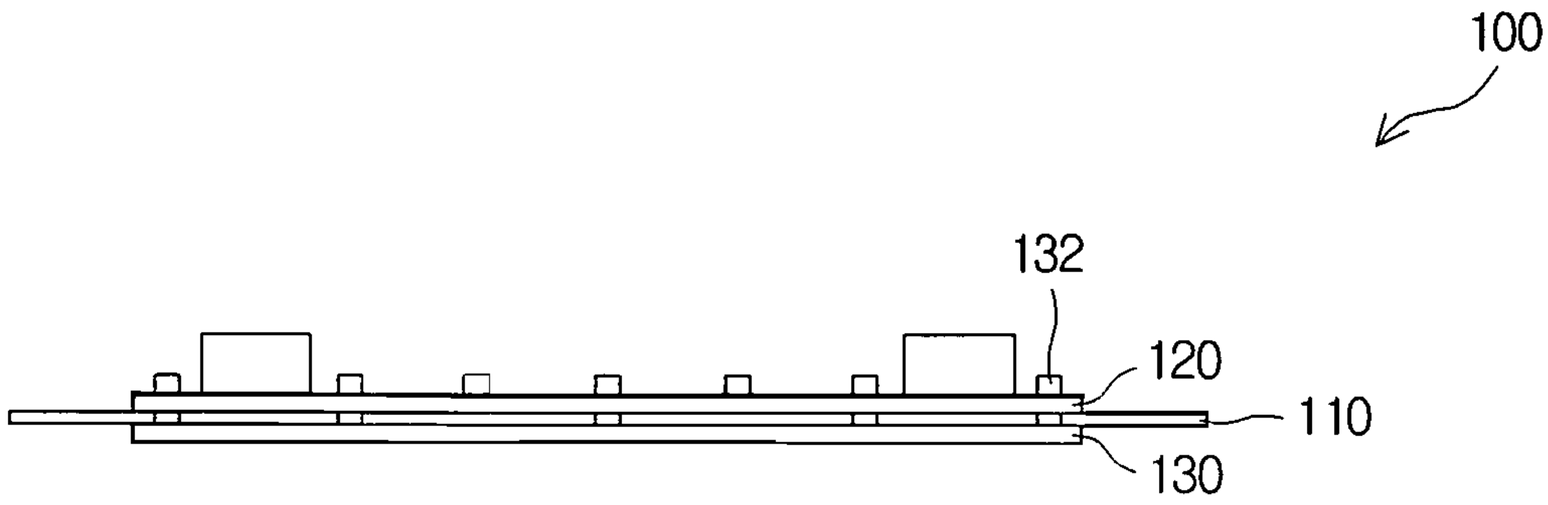


FIG. 3



FUEL CELL

CROSS-REFERENCE TO RELATED APPLICATIONS

This application claims the benefit of Korean Patent Application No. 10-2008-0038353 filed with the Korean Intellectual Property Office on Apr. 24, 2008, the disclosure of which is incorporated herein by reference in its entirety.

BACKGROUND

1. Technical Field

The present invention relates to a fuel cell

2. Description of the Related Art

Today, portable electronic apparatuses are being provided in smaller sizes and with a greater variety of functions, and accordingly, there has been a demand for higher efficiency and longer operation times in devices for supplying electrical power to such portable electronic apparatuses. In this context, the fuel cell, which converts chemical energy directly into electrical energy, is gaining importance as a new alternative for radically increasing the efficiency and durability of a portable power supply.

According to the related art, the fuel cell is manufactured by stacking current collectors, flow field plates, and a membrane electrode assembly having an anode, a cathode, and an electrolyte membrane, and then applying pressure evenly using end plates. Here, thick end plates are tightened together using a fastening means such as bolts, in order to improve the efficiency by reducing contact resistance between pertinent elements and preventing a leak of fuel. Accordingly, the overall size of the fuel cell is increased, thereby making it difficult to employ the fuel cell in portable electronic apparatuses.

SUMMARY

The present invention provides a fuel cell that can reduce contact resistance between pertinent elements and its overall size and prevent a leak of fuel.

An aspect of the invention features a fuel cell including a membrane electrode assembly (MEA), configured to convert a chemical energy to an electrical energy; a first end plate, stacked on one surface of the MEA and formed with a first coupling hole; a second end plate, stacked on the other surface of the MEA; and a protrusion, formed on the second end plate such that the protrusion penetrates the first coupling hole and an end part of the protrusion protrudes a surface of the first end plate, and the end part being transformed such that the end part couples the first end plate and the second end plate.

The end part of the protrusion can be transformed not to protrude to a surface of the first end plate.

The MEA can be formed with a second coupling hole, a plurality of first coupling holes can be formed such that at least some of the first coupling holes correspond to the second coupling hole, and a plurality of protrusions can be formed such that at least some of the protrusions penetrate the second coupling hole.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is an exploded perspective view showing a fuel cell in accordance with an embodiment of the present invention;

FIG. **2** is a plan view showing a fuel cell in accordance with an embodiment of the present invention; and

FIG. **3** is a front view showing an end part of a protrusion of a fuel cell before the end part is transformed in accordance with an embodiment of the present invention.

DETAIL DESCRIPTION

A fuel cell according to certain embodiments of the invention will be described below in more detail with reference to the accompanying drawings. Those elements that are the same or are in correspondence are rendered the same reference numeral regardless of the figure number, and redundant explanations can be omitted.

When one element is described as being "stacked on" or "coupled to" another element, it shall be construed not only as being stacked on or coupled to another element directly but also as possibly having yet another element in between.

FIG. **1** is an exploded perspective view showing a fuel cell in accordance with an embodiment of the present invention, and FIG. **2** is a plan view showing a fuel cell in accordance with an embodiment of the present invention. FIG. **3** is a front view showing an end part of a protrusion of a fuel cell before the end part is transformed in accordance with an embodiment of the present invention.

In FIG. **1** through FIG. **3**, there are shown a fuel cell **100**, a membrane electrode assembly (MEA) **110**, a first coupling hole **122**, a first end plate **120**, a second coupling hole **112**, a second end plate **130**, and a protrusion **132**.

In accordance with an embodiment of the present invention, the fuel cell **100** can reduce contact resistance between pertinent elements and its overall size and weight and prevent a leak of fuel. Moreover, in the manufacturing process, the end plates and the MEA **110** can be easily and precisely arranged, thereby improving reproducibility and repetition required for mass production.

The MEA **110** can convert chemical energy to electrical energy. Herein, the MEA **110** can be formed to include an anode, a cathode, and an electrolyte membrane interposed therebetween. Below described in detail are the anode, the cathode, and the electrolyte membrane.

The electrolyte membrane can be interposed between the anode and the cathode and move hydrogen ions generated by an oxidation reaction at the anode to the cathode. It can be also possible to use a polymer material.

In particular, the anode can be formed on one side of the electrolyte membrane and be supplied with a fuel such as hydrogen or methanol, and then can undergo an oxidation reaction at a catalyst layer of the anode to generate hydrogen ions and electrons. The cathode can be formed on the other side of the electrolyte membrane and be supplied with oxygen and the electrons generated at the anode, and then can undergo a reduction reaction at the catalyst layers of the cathodes to generate oxygen ions.

The anode and the corresponding cathode can generate electrical energy through the chemical reactions as shown in the following reaction schemes 1 and 2 according to the type of the fuel. Here, the reaction scheme 1 is related to hydrogen, and the reaction scheme 2 is related to methanol.

[Reaction Scheme 1]

Anode:	$H_2 \rightarrow 2H^+ + 2e^-$
Cathode:	$O_2 + 4H^+ + 4e^- \rightarrow 2H_2O$
Overall Reaction:	$2H_2 + O_2 \rightarrow 2H_2O$

[Reaction Scheme 2]

Anode:	$CH_3OH + H_2O \rightarrow CO_2 + 6H^+ + 6e^-$
Cathode:	$1.5O_2 + 6H^+ + 6e^- \rightarrow 3H_2O$
Overall Reaction:	$CH_3OH + 1.5O_2 \rightarrow CO_2 + 2H_2O$

The first end plate **120** can be stacked on one surface of the MEA **110** and be formed with the first coupling hole **122**. In particular, the first end plate **120** can be formed with the first coupling hole **122** to be penetrated by the protrusion **132** being formed on the second end plate **130** such that the first end plate **120** can be coupled to the second end plate **130** by the transformation of an end part of the protrusion **132** to provide a pressure to the MEA **110**. A length of the protrusion **132**, which is formed on a first surface of the second end plate **130**, is larger than a thickness of the first end plate **120**.

The first coupling hole **122** can be formed in various ways by using chemical or mechanical methods using a laser or a drill.

The second end plate **130** can be stacked on the other surface of MEA **110** and be coupled to the first end plate **120** by the protrusion **132** penetrating the first coupling hole **122**.

The protrusion **132** can be formed on the second end plate **130** such that the protrusion **132** can penetrate the first coupling hole **122** and an end part of the protrusion **132** protrude to the surface of the first end plate **120**. The end part of the protrusion **132** can be transformed to have a dome, mushroom or plate shape, for example, such that the first end plate **120** can be coupled to the second end plate **130**. Accordingly, the first end plate **120** can be coupled to the second end plate **130** by the transformation of the end part of the protrusion **132**.

In other words, the second end plate **130** can be formed with the protrusion **132** for being coupled to the first end plate **120**, and the protrusion **132** can penetrate the first coupling hole **122** of the first end plate **120**. Accordingly, the MEA **110** can be stacked on the second end plate **130**, and the first end plate **120** can be stacked such that the protrusion **132** can penetrate the first coupling hole **122**. Then, an end part of the protrusion **132**, which protrudes to a surface of the first end plate **120**, can be transformed to have a dome, mushroom or plate shape by physical pressure. Accordingly, the first end plate **120** and the second end plate **130** can be compressed and coupled to each other.

Since the first end plate **120** and the second end plate **130** are coupled to each other by the transformation of the end part of the protrusion **132**, the first end plate **120** and the second end plate **130**, which are closely coupled to each other, can provide strong pressure to the MEA **110** and prevent a leak of fuel. Moreover, using no fastening means such as bolts can reduce the overall thickness of the fuel cell **100** as compared with using the fastening means to couple the first end plate **120** to the second end plate **130** according to the related art.

Moreover, since the protrusion **132** is formed on the second end plate **130** as one body, the first end plate **120**, the MEA **110**, and the second end plate **130** can be arranged by arranging positions of the MEA **110** and the first end plate **120**. This can help to manufacture the fuel cell **100** more easily. Accordingly, the reproducibility and repetition of workers can be improved, thereby manufacturing the fuel cell **100** in great quantities without difficulty.

On the other hands, when the first end plate **120** is coupled to the second end plate **130** through the protrusion **132**, the end part of the protrusion **132** can be transformed not to protrude to a surface of the first end plate **120**. In other words, when the first end plate **120** is coupled to the second end plate **130** by physically pressing an end part of the protrusion **132** formed on the second end plate **130** as one body, the end part of the protrusion **132** can be transformed and flatten to have a thin plate shape, thereby reducing the overall thickness of the fuel cell **100** efficiently.

Alternatively, the MEA **100** can be formed with a plurality of second coupling hole **112**, and a plurality of first coupling holes **122** can be also formed on the first end plate **120** such that at least some of the first coupling holes **122** can correspond to the second coupling holes **122**. A plurality of protrusions **132** can be formed on the second end plate **130** as one body such that at least some of the protrusions **132** can penetrate the second coupling holes **112**.

In other words, since the MEA **110** can be formed with the second coupling holes **112** and the protrusions **132**, formed on the second end plate **130** as one body, and some of the first coupling holes **122** of the first end plate **120** can be formed to correspond to the second coupling holes **112**, outer parts of the end plates on which no MEA **110** is stacked can be coupled to each other by the transformation of the end part of the protrusion **132**, and simultaneously, the parts on which the MEA **110** is stacked can be coupled to each other by the transformation of the end part of the protrusion **132**. This can provide strong and uniform pressure to the MEA **110**, and as a result, it can be possible to reduce contact resistance between pertinent elements and prevent a leak of fuel efficiently.

If all of the protrusions **132** and the first coupling holes **122** correspond to the second coupling holes **112**, or if the protrusions **132**, the first coupling holes **122** and the second coupling holes, all having the same number, can placed at the positions that correspond to each other, the parts on which the MEA **110** is stacked can coupled to each other by the transformation of the end part of the protrusion **132**.

Like the first coupling hole **122**, the second coupling hole **112** can be formed in various ways by using chemical or mechanical methods using a laser or a drill.

On the other hand, the first end plate **120** and the second end plate **130** can be made of a metal or a plastic, and in the case of the metal, the end plates **120** and **130** may be required to undergo an anodizing process or to be coated by using a Tefron for insulation.

Many embodiments other than those set forth above can be found in the appended claims.

While the spirit of the invention has been described in detail with reference to particular embodiments, the embodiments are for illustrative purposes only and do not limit the invention. It is to be appreciated that those skilled in the art can change or modify the embodiments without departing from the scope and spirit of the invention.

What is claimed is:

1. A fuel cell, comprising:

a membrane electrode assembly (MEA), configured to convert a chemical energy to an electrical energy;

a first end plate, stacked on a first surface of the MEA and formed with a first coupling hole, a first surface of the first end plate facing the first surface of the MEA and the first coupling hole penetrating the first end plate;

a second end plate, stacked on a second surface of the MEA, a first surface of the second end plate facing the second surface of the MEA; and

a protrusion, formed on the first surface of the second end plate such that the protrusion penetrates the first coupling hole from the first surface of the first end plate to a second surface of the first end plate and an end part of the protrusion protrudes from the second surface of the first

end plate, a length of the protrusion being larger than a thickness of the first end plate,

wherein the end part of the protrusion is transformed to have a dome, mushroom or plate shape by physical pressure, and

the first end plate and the second end plate are compressed and coupled to each other by transformation of the end part of the protrusion.

2. The fuel cell of claim **1**, wherein the MEA is formed with a second coupling hole,

a plurality of first coupling holes are formed such that at least some of the first coupling holes correspond to the second coupling hole, and

a plurality of protrusions are formed such that at least some of the protrusions penetrate the second coupling hole.

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